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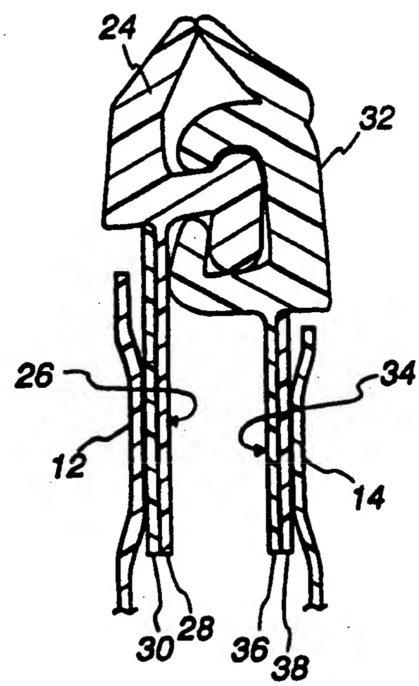
(54) Title: MULTI-LAYER FINS FOR PLASTIC ZIPPER BAGS

(57) Abstract

The present invention provides a plastic bag to which a zipper (24, 32) having fins (26, 34) may be attached without fusing the fins together. The bag has an excellent seal between the fins and the respective body panels (12, 14) of the plastic bag. The zipper includes a male and female track. The male track includes a male profile (24) and a first fin (26) with the first fin having an inner layer (28) and an outer layer (30). The female track includes a female profile (32) and a second fin (34) with the second fin having an inner layer (36) and an outer layer (38), in which the inner layers of the fins are formed from a higher melting point material than the outer layers of the fins. Preferably, the inner layer should have a melting point at least about 5 °C higher than the outer layer seal to be produced between the fins and their respective body panels without fusing the fins to each other. Some examples of higher melting point material resins comprising the inner layer include the following: high density polyethylene (HDPE), linear low density polyethylene (LLDPE), metallocene-catalyzed LLDPE, polypropylene (PP) and ethylene-propylene copolymer (E-P copolymer). Resins comprising the lower melting outer layer include the following: ethylene vinyl acetate copolymer (EVA), low density polyethylene (LDPE), very low density polyethylene (VLDPE), LLDPE and metallocene-catalyzed LLDPE.



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MULTI-LAYER FINS FOR PLASTIC ZIPPER BAGS

FIELD OF THE INVENTION

The present invention relates generally to plastic bags. More particularly, the present invention relates to use of particular polymers for the fins in plastic bags to prevent the fins from inadvertently fusing together when sealed to the body panels of the plastic bag.

BACKGROUND OF THE INVENTION

One type of plastic bag includes first and second opposing body panels fixedly connected to each other along a pair of sides and a bottom, in which the bottom extends between the pair of sides. The bag preferably includes a fastener such as a zipper extending along a mouth formed opposite the bottom of the plastic bag. The zipper includes a male track and a female track. The male track includes a male profile and a first depending fin or flange extending downward from the male profile. Likewise, the female track includes a female profile and a second depending fin or flange extending downward from the female profile. The first and second fins may be extruded separately from the body panels and then thermally fused to inner surfaces of the respective first and second body panels.

Examples of plastic bags having first and second fins extruded separately from the body panels are disclosed by Herrington et al. in U.S. Pat. Nos. 5,007,143; 5,070,194; 5,131,121; 5,152,613 and 5,301,395, which are incorporated herein by reference in their entirety. When fusing inner surfaces of the first and second body panels to their respective fins to create a seal (the "fin seal"), difficulty arises in applying just enough heat and pressure to the fins to fuse the fins to the bag, but not so much as to shut the bag opening by fusing the fins together. In the past, a metal plate or the like was positioned between the first and second fins to prevent the fusing thereof.

Therefore, a need exists for a plastic bag that allows the panels of the plastic bag to be fused to their respective fins without fusing the first and second fins to each other.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a plastic bag in which first and second fins will not be inadvertently fused together. It is another object of the present invention to produce an excellent fin seal by allowing heat and pressure thereto without fusing the fins together. Yet another object is to eliminate the need for a metal plate or the like placed between the first and second fins when the fins are fused to their respective body panels.

The plastic bag comprises first and second opposing panels fixedly connected to each other along a pair of sides and a bottom bridging the pair of sides. The pair of sides and the bottom define a receptacle space having a mouth formed opposite of the bottom. The plastic bag has a zipper which includes a male and female track. The male track includes a male profile and a first fin with the first fin having an inner layer and an outer layer. The female track includes a female profile and a second fin with the second fin having an inner layer and an outer layer.

In the present invention, the inner layers of the fins are formed from a higher melting point material than the outer layers of the fins. The term "layer" as used herein shall include any coating, film, lamination, coextrusion or the like. Preferably, the inner layer should have a melting point at least about 5° C higher than the outer layer which will create the fin seal without fusing the fins together. The difference between the melting points is more preferably at least about 10° C.

Some examples of higher melting point materials of which the inner layer is comprised include the following resins: high density polyethylene (HDPE), linear low density polyethylene (LLDPE), metallocene-catalyzed LLDPE, polypropylene (PP) and ethylene-propylene copolymer (E-P copolymer). Resins of which the lower melting outer layer is comprised include the following: ethylene vinyl acetate copolymer (EVA), low density polyethylene (LDPE), very low density polyethylene (VLDPE), LLDPE and metallocene-catalyzed LLDPE.

BRIEF DESCRIPTION OF THE FIGURES

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the figures in which:

FIG. 1 is an isometric view of a plastic bag embodying the present invention; and

FIG. 2 is a sectional view generally taken along line 2-2 in FIG. 1.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the figures, FIGS. 1 and 2 depict a plastic bag embodying the present invention. The plastic bag 10 comprises first and second opposing body panels 12 and 14 fixedly connected to each other along a pair of sides 16 and 18 and a bottom 20. The bottom 20 extends between the pair of sides 16 and 18. The bag 10 preferably includes a fastener such as a zipper 22 extending along a mouth formed opposite the bottom 20 of the plastic bag 10. The zipper 22 includes a male track and a female track. The male track includes a male profile 24 and a first depending fin or flange 26 extending downward from the male profile 24. The first fin 26 includes an inner layer 28 and an outer layer 30. Likewise, the female track includes a female profile 32 and a second depending fin or flange 34 extending downward from the female profile 32. The second fin 34 includes an inner layer 36 and an outer layer 38. The outer layers 30 and 38 of the fins are thermally fused to inner surfaces of the respective first and second body panels 12 and 14.

To assist in opening the plastic bag 10, a slider 40 is slidably mounted to the zipper 22 for movement between a closed position and an open position. In the open position of the slider 40, the male and female profiles 24 and 32 are disengaged from each other so that a user can gain access to the interior of the plastic bag 10.

Movement of the slider 40 from the open position to the closed position (see FIG. 2) interlocks the male and female profiles 24 and 32 so as to restrict access to the interior of the plastic bag 10.

End termination clamps 42 are mounted to opposite ends of the zipper 22. The end clamps 42 prevent the slider 40 from going past the ends of the zipper 22 and hold the male and female profiles 24 and 32 together to resist stresses applied to the profiles during normal use of the plastic bag 10. Further details concerning the construction and operation of the slider 40 and the end clamps 42 may be obtained from United States Patent No. 5,067,208 to Herrington, Jr. et al., which is incorporated herein by reference in its entirety.

To prevent unwanted fusion between the inner layer 28 of the first fin 26 and the inner layer 36 of the second fin 34, a multi-layered fin structure having inner layers 28 and 36 with significantly different melting and/or sealing characteristics than the outer layers 30 and 38. The multi-layered fin structure includes the inner layer 28 and outer layer 30 of the first fin 26 and also includes the inner layer 36 and the outer layer 38 of the second fin 34. The inner layers 28 and 36 are formed with higher melting point materials that prevent the opening of the plastic bag from being fused shut when sealing the outer layers 30 and 38 made of lower melting point materials to their respective body panels 12 and 14. Thus, the inner layers 28 and 36 are formed with melting point materials higher than the outer layers 30 and 38 to avoid this unwanted fusion. The outer layers 30 and 38 are formed with relatively lower melting point materials to enhance the fin seals with the respective body panels 12 and 14.

The resins preferred for comprising the inner layers 28 and 36 include the following: high density polyethylene (HDPE), linear low density polyethylene (LLDPE), metallocene-catalyzed LLDPE, polypropylene (PP) and ethylene-propylene copolymer (E-P copolymer). The inner layers 28 and 36 may be comprised of different resins. The resins preferred for comprising the outer layers 30 and 38 include the following: ethylene vinyl acetate copolymer (EVA), low density polyethylene (LDPE), very low density polyethylene (VLDPE), LLDPE and metallocene-catalyzed LLDPE. The outer layers 30 and 38 may be comprised of

different resins. However, the present invention of a multi-layered fin structure is not limited to the above named resins. For example, other resins, such as nylons or polyesters, which have higher melting points can also comprise the inner layers 28 and 36. The use of resins like nylons and polyesters would typically require the addition of an adhesive to bind the outer and inner layers together.

The inner layers 28 and 36 or the outer layers 30 and 38 may comprise more than one of the above named resins. For example, the inner layers 28 and 36 of the fin may comprise an E-P copolymer, while the outer layers 30 and 38 of the fin may comprise LLDPE and LDPE. The LDPE and LLDPE pure resins may be blended prior to extrusion or may be coextruded. The preferred method is to coextrude the LDPE and LLDPE pure resins. It may be more economical for certain applications not to have inner layers 28 and 36 and outer layers 30 and 38 constructed entirely of polymers. Other materials, such as silicon coatings or slip additives, may be added to the above-named resins. When incorporating more than one resin in the first fin 26 or second fin 34, it is preferable that at least a 5° C differential in the melting point of the resins forming the outer and inner layers of the fins is maintained to prevent unwanted fusion between the inner layers 28 and 36. It is more preferable to have at least a 10°C differential in the melting point of the resins forming the outer and inner layers of the fins. Other ranges contemplated include at least a 15°C, at least a 20°C and at least a 40°C differential in the melting point of the resins forming the outer and inner layers of the fin. The fins 26 and 34 are preferably formed by coextruding the respective inner layers 28 or 36 with the respective outer layer 30 or 38.

Specific embodiments of the above resins comprising the inner and outer layers of the fins are outlined below. In the first embodiment, the inner layers 28 and 36 of the fin comprise HDPE, while the outer layers 30 and 38 of the fin comprise EVA. The HDPE resin has a density of from about 0.935 to about 0.965 g/cm^3, preferably from about 0.940 to about 0.960 g/cm^3, and more preferably from about 0.945 to about 0.955 g/cm^3; a melting point of from about 125° C to about 135° C; and a molecular weight distribution, or polydispersity, (M_w/M_n or MWD) of from about 2 to about 35, preferably from about 3 to about 25, and more preferably from about 4 to 20.

The melt flow ratio (MFR) is defined as I_{20}/I_2 and determined in accordance to ASTM D-1238. The MFR of the HDPE resin is generally from about 20 to about 220, preferably from about 25 to about 150, and more preferably from about 30 to about 100. The melt index (MI) is defined as the I_2 value. The melt index for the HDPE resin is from about 0.035 to about 20, and preferably from about 0.040 to about 10.

The EVA resin has a density of from about 0.920 to about 0.955 g/cm^3, preferably from about 0.925 to about 0.940 g/cm^3, and more preferably from about 0.925 to about 0.935 g/cm^3. The EVA resin will preferably have a melting point of from about 90° C to about 105° C. The EVA resin has a molecular weight distribution or polydispersity of from about 3 to about 15, preferably from about 4 to about 12, and more preferably from about 6 to 10. The melt flow ratio of the EVA resin is generally from about 40 to about 160, preferably from about 80 to about 140, and more preferably from about 90 to about 130. The melt index for the EVA resin is generally from about 0.1 to about 20, and preferably from about 0.1 to about 5.

In the second embodiment, the inner layers 28 and 36 of the fins comprise LLDPE, while the outer layers 30 and 38 of the fins comprise LDPE.

The LLDPE resin has a density of from about 0.89 to about 0.94 g/cm^3, preferably from about 0.915 to about 0.930 g/cm^3, and more preferably from about 0.920 to about 0.925 g/cm^3; a melting point of from about 115° C to about 130° C; a polydispersity of from about 1 to about 4, preferably from about 2 to 4, and more preferably from about 2.5 to 3.5; a melt index of from about 0.5 to about 30 and preferably from about 1 to about 10; and a melt flow ratio of from about 12 to about 35 and preferably from about 15 to about 28. The comonomer for LLDPE preferably has from 4-10 carbon atoms and more preferably 6-8 carbon atoms.

The LDPE resin has a density of from about 0.88 to about 0.935 g/cm^3, preferably from about 0.905 to about 0.930 g/cm^3, and more preferably from about 0.915 to about 0.925 g/cm^3; a melting point of from about 95° C to about 115° C; a molecular weight distribution, or polydispersity, from about 3 to about 15, preferably from about 4 to about 12, and more preferably from about 6 to 10; a melt flow ratio of from about 40 to about 160, preferably from about 80 to about 140, and more

preferably from about 90 to about 130; and a melt index of from about 0.1 to about 20, and preferably from about 0.1 to about 5.

In the third embodiment, the inner layers 28 and 36 of the fins comprise polypropylene, while the outer layers 30 and 38 of the fins comprise VLDPE.

Polypropylene has a density of from about 0.880 to about 0.912 g/cm^3, preferably from about 0.890 to about 0.908 g/cm^3, and more preferably from about 0.900 to about 0.906 g/cm^3; a melting point of from about 155° C to about 170° C; a polydispersity of from about 2 to about 20, preferably from about 2.5 to 8.0, and more preferably from about 3 to 5; and a melt index of from about 0.3 to about 20 and preferably from about 2 to about 10.

The VLDPE resin has a density of from about 0.85 to about 0.915 g/cm^3, preferably from about 0.88 to about 0.910 g/cm^3, and more preferably from about 0.900 to about 0.905 g/cm^3; a melting point of from about 100° C to about 120° C; a molecular weight distribution, or polydispersity, from about 1.0 to about 4.0, preferably from about 2.0 to about 4.0, and more preferably from about 2.5 to 3.5; a melt flow ratio from about 12 to about 35, preferably from about 14 to about 30, and more preferably from about 15 to about 28; and a melt index of from about 0.1 to about 20, preferably from about 0.5 to about 5.0.

In the fourth embodiment, the inner layers 28 and 36 of the fins comprise E-P copolymer, while the outer layers 30 and 38 of the fins comprise LLDPE.

The E-P copolymer has a density of from about 0.880 to about 0.950 g/cm^3, preferably from about 0.890 to about 0.930 g/cm^3, and more preferably from about 0.900 to about 0.902 g/cm^3; a melting point of from about 130° C to about 170° C; an average molecular weight of from about 150,000 to about 1,000,000, preferably from about 225,000 to 700,000, and more preferably from about 300,000 to 500,000; and a melt index of from about 0.3 to about 20 and preferably from about 2 to about 10.

The LLDPE resin comprising the outer layer 30 and 38 of the fin is the same LLDPE resin described in detail above in the second embodiment where the LLDPE resin comprised the inner layer 28 and 36 of the fin.

The most preferred of the above embodiments is the first embodiment in which HDPE comprises the inner layers 28 and 36 of the fins and EVA comprises the

outer layers 30 and 38. The choice of resins for the first embodiment is based on one or more of the following considerations: compatibility in coextruding the resins, the resin cost, and the familiarity associated with the resins.

The resins LLDPE, VLDPE and metallocene-catalyzed LLDPE are copolymers prepared, preferably, with ethylene and at least one alpha olefin monomer, *e.g.* a copolymer or terpolymer. The alpha olefin monomer generally has from 3 to about 12 carbon atoms, preferably from 4 to 10 carbon atoms, and more preferably from 6 to 8 carbon atoms. The alpha olefin comonomer content is generally below about 30 weight percent, preferably below about 20 weight percent, and more preferably from about 1 to about 15 weight percent. Exemplary comonomers include propylene, 1-butene, 1-pentene, 1-hexene, 3-methyl-1-pentene, 4-methyl-1-pentene, 1-octene, 1-decene, and 1-dodecene.

The average molecular weight of the resins LLDPE, VLDPE and metallocene-catalyzed LLDPE can generally range from about 20,000 to about 500,000, preferably from about 50,000 to about 200,000. The molecular weight is determined by commonly used techniques such as size exclusion chromatography or gel permeation chromatography.

Resin materials which may be used for the metallocene-catalyzed LLDPE are available from, among others, Dow Chemical Company and Exxon Chemical Company who are producers of single site or constrained geometry catalyzed polyethylenes. These resins are commercially available as the AFFINITY and EXXACT polyethylenes (see *Plastics World,* pp. 33-36, Jan. 1995), and also as the ENHANCED POLYETHYLENE and EXCEED line of resins. The manufacture of such polyethylenes, generally by way of employing a metallocene catalyst system, is set forth in, among others, U.S. Pat. Nos. 5,382,631, 5,380,810, 5,358,792, 5,206,075, 5,183,867, 5,124,418, 5,084,534, 5,079,205, 5,032,652, 5,026,798, 5,017,655, 5,006,500, 5,001,205, 4,937,301, 4,925,821, 4,871,523, 4,871,705, and 4,808,561, each of which is hereby incorporated herein by reference in its entirety. These catalyst systems and their use to prepare such fin enhancing resin materials are also set forth in EP 0 600 425 A1 and PCT applications WO 94/25271 and 94/26816. The polyethylene resins thus produced generally have a crystalline content in excess of at

least 10 weight percent, generally in excess of at least 15 weight percent. In a preferred embodiment metallocene catalysts are utilized, however, other catalysts, such as single-site catalysts are available as equivalent substitutes.

The above patents and publications generally report that these metallocene catalysts contain one or more cyclopentadienyl moieties in combination with a transition metal. The metallocene catalyst may be represented by the general formula $C_cMA_aB_b$ wherein C is a substituted or unsubstituted cyclopentadienyl ring; M is a Group 3-10 metal or Lanthanide series element, generally a Group IVB, VB, or VIB metal; A and B are independently halogen, hydrocarbyl group, or hydrocarboxyl groups having 1-20 carbon atoms; a = 0-3, b = 0-3, and c = 1-3. The reactions can take place in either gas phase, high pressure, slurry, or solution polymerization schemes.

While the present invention has been described with reference to one or more particular embodiments, those skilled in the art will recognize that many changes may be made thereto without departing from the spirit and scope of the present invention. Each of these embodiments and obvious variations thereof are contemplated as falling within the spirit and scope of the claimed invention, which is set forth in the following claims.

WHAT IS CLAIMED IS:

1. A plastic bag, comprising:

first and second opposing panels fixedly connected to each other along a pair of sides and a bottom bridging said pair of sides, said pair of sides and said bottom defining a receptacle space having a mouth formed opposite of said bottom; and

a zipper including a male and female track, said male track including a male profile and a first fin, said first fin including an inner layer and an outer layer, said female track including a female profile and a second fin, said second fin including an inner layer and an outer layer, said inner layers of said first and second fins having a higher melting point than the melting point of said outer layers of said first and second fin.

2. The plastic bag according to claim 1 wherein the melting point differential is at least 5° C.

3. The plastic bag according to claim 2 wherein the melting point differential is at least 10° C.

4. The plastic bag according to claim 3 wherein the melting point differential is at least 15° C.

5. The plastic bag according to claim 4 wherein the melting point differential is at least 20° C.

6. The plastic bag according to claim 5 wherein the melting point differential is at least 40° C.

7. The plastic bag according to claim 1 wherein each of said inner layers of said fins is a high density polyethylene, a linear low density polyethylene, a polypropylene, an ethylene-propylene copolymer or a metallocene-catalyzed linear low density polyethylene.

8. The plastic bag according to claim 1 wherein each of said outer layers of said fins is an ethylene vinyl acetate copolymer, low density polyethylene resin, a very low

density polyethylene, a linear low density polyethylene or a metallocene-catalyzed linear low density polyethylene.

9. The plastic bag according to claim 1 wherein each of said inner layer of said fins comprise high density polyethylene and each of said outer layers of said fins comprise an ethylene vinyl acetate copolymer.

10. The plastic bag according to claim 9 wherein said high density polyethylene has a melting point of from about 125° to about 135° C.

11. The plastic bag according to claim 9 wherein said ethylene vinyl acetate copolymer has a melting point of from about 90° C to about 105° C.

12. The plastic bag according to claim 9 wherein said high density polyethylene has a polydispersity of from about 2 to about 35.

13. The plastic bag according to claim 9 wherein said high density polyethylene has a density of from about 0.935 to about 0.965 g/cm^3.

14. The plastic bag according to claim 9 wherein said high density polyethylene has a melt index of from about 0.035 to about 20.

15. The plastic bag according to claim 9 wherein said high density polyethylene has a melt flow ratio of from about 20 to about 220.

16. The plastic bag according to claim 9 wherein said ethylene vinyl acetate copolymer has a polydispersity of from about 3 to about 15.

17. The plastic bag according to claim 9 wherein said ethylene vinyl acetate copolymer has a density of from about 0.920 to about 0.955 g/cm^3.

18. The plastic bag according to claim 1 wherein each of said inner layers of said fins comprise linear low density polyethylene and each of said outer layers of said fins comprise a low density polyethylene resin.

19. The plastic bag according to claim 1 wherein each of said inner layers of said fins comprise polypropylene and each of said outer layers of said fins comprise a very low density polyethylene resin.

20. The plastic bag according to claim 1 wherein each of said inner layers of said fins comprise an ethylene-propylene copolymer and each of said outer layers of said fins comprise a linear low density polyethylene resin.

21. A fastener for a plastic bag, comprising:

a male track including a male profile and a first fin; and

a female track including a female profile and a second fin, said first and second fin including an inner layer and an outer layer, said inner layers of said first and second fins having a higher melting point than the melting point of said outer layers of said first and second fin.

22. The plastic bag according to claim 21 wherein the melting point differential is at least 5° C.

23. The plastic bag according to claim 22 wherein the melting point differential is at least 15° C.

24. The plastic bag according to claim 23 wherein the melting point differential is at least 40° C.

25. The plastic bag according to claim 21 wherein each of said inner layers of said fins is a high density polyethylene, a linear low density polyethylene, a polypropylene, an ethylene-propylene copolymer or a metallocene-catalyzed linear low density polyethylene.

26. The plastic bag according to claim 21 wherein each of said outer layers of said fins is an ethylene vinyl acetate copolymer, low density polyethylene resin, a very low density polyethylene, a linear low density polyethylene or a metallocene-catalyzed linear low density polyethylene.

27. The plastic bag according to claim 21 wherein each of said inner layer of said fins comprise high density polyethylene and each of said outer layers of said fins comprise an ethylene vinyl acetate copolymer.

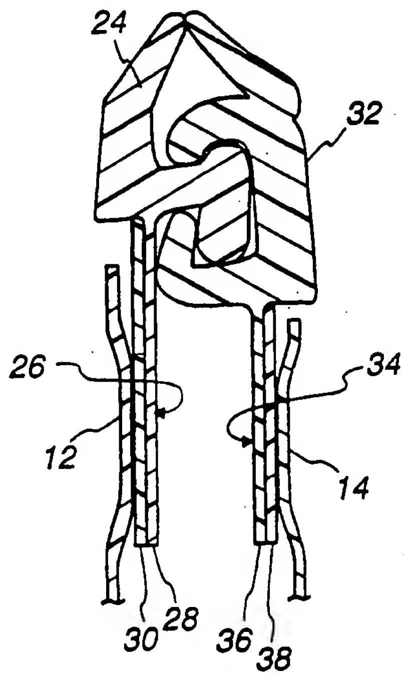

Fig. 2

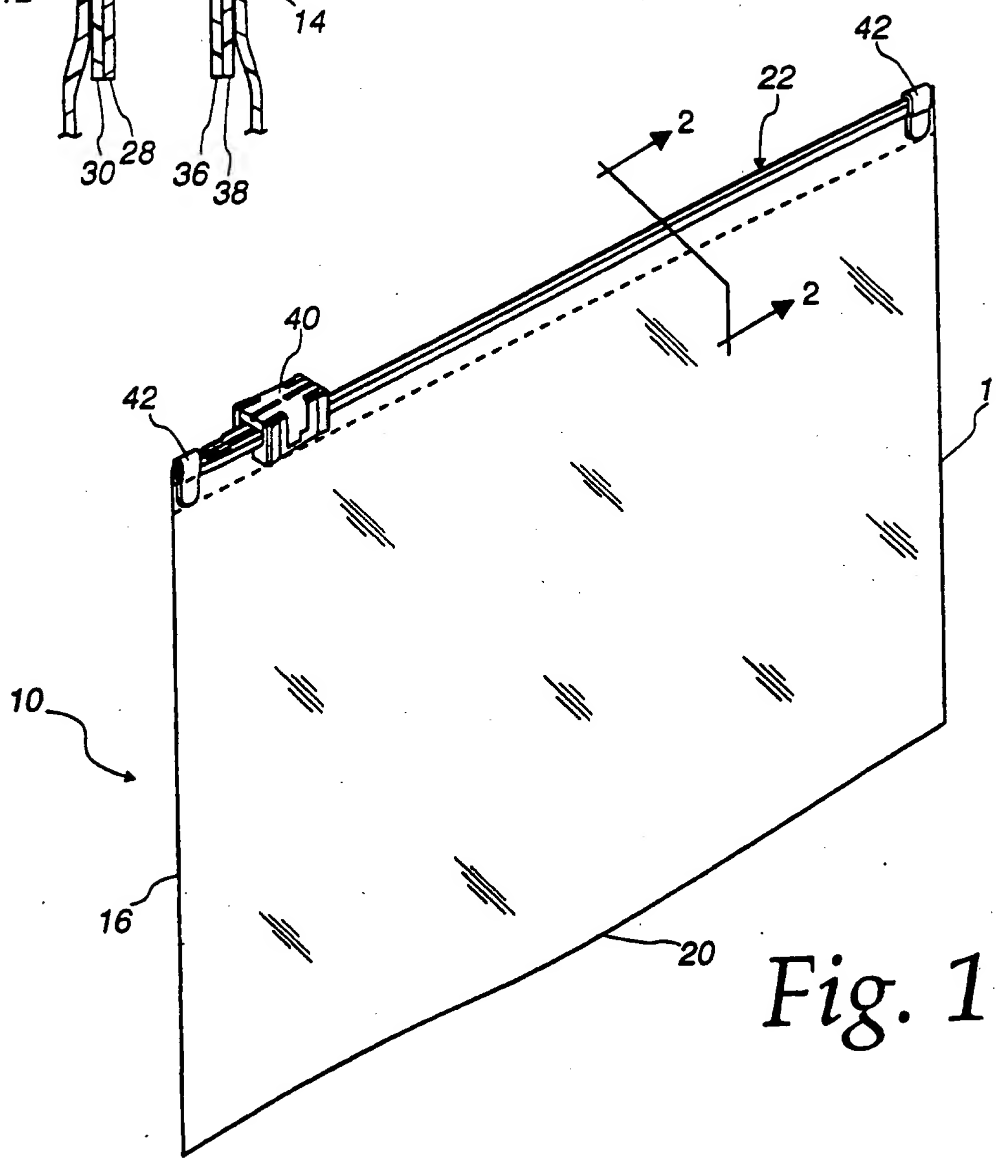

Fig. 1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/19461

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65D33/25 A44B19/16 C08L23/04

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65D A44B C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 371 402 A (IDEMITSU PETROCHEMICAL) 6 June 1990 see the whole document -----	1,7-9, 18-21, 25-27

[ ] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Information on patent family members

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